

REMARKS

By this amendment, claims 1-12, 14, 15, 24-36 are pending in the application. Claims 1, 4, 5, and 9-11 are amended, and claim 16 is canceled. The claim amendments and additional claims are supported by the specification, and no new matter is added.

Furthermore, the above amendments introduce **no new issues** requiring further search or consideration. The amendments merely incorporated limitations from dependent claims into the independent claims and/or correct minor formalities, as follows:

Claim 1 has been amended to incorporate limitations from dependent claim 5 thereinto. Claims 4, 5, and 9 have been amended to make the language of the remaining limitations consistent with amended claim 1.

Claim 10 has been rewritten in independent form, a typographical error (line 8) has been corrected, and an antecedent basis problem (line 16) has been corrected. The amendment has been made with the intention of not changing the scope of rejected claim 10.

The limitations of dependent claim 16 have been incorporated into independent claim 11 and an antecedent basis problem has been corrected.

Entry of the amendments after final is therefore requested. The remaining independent claims have not been amended.

Drawings

Applicant appreciates the Examiner's approval of the drawing changes of April 30, 1999. Formal correction will be made at the time of an indication of the allowability of the present case.

Rejections under 35 USC 102

The Examiner rejected claims 1, 2, 11, 31, and 33 under 35 USC 102(b) as being anticipated by U.S. Patent 5,137,701 to Mundt (Mundt). The rejection as it applies to the present claims is traversed.

In distinct contrast to Mundt, amended claim 1 is directed to a gas treatment apparatus for reducing a hazardous gas content of an effluent from a process chamber comprising, inter alia, an exhaust tube to reduce the hazardous gas content of the effluent and having an internal flow surface that is substantially absent projections or recesses that alter the effluent flow path. Mundt discloses no such exhaust tube. The reactor of Mundt is replete with projections and/or recesses **that alter** the effluent flow path. The reaction chamber (18) of Mundt further comprises two tube-shaped masses of fibrous material. A first tube (74) defines a reactive element and has an outer diameter slightly less than the diameter of a baffle member (60). A second tube (76) defines a tubular condensation element and has an inner diameter slightly larger than the baffle member and an outer diameter slightly less than the inner diameter of the chamber. The fibrous meshes (74,76) have a cross-section that is 50 percent open and 50 percent closed to a gas flow (column 8, lines 8-11). The fibrous meshes are only 50 percent open. The other 50 percent, therefore, must be a projection that alters the effluent flow path. Furthermore, the baffle of Mundt serves as a projection to redirect the flow of the effluent, as does a tube (80) in the reactor. All of these features alter the effluent flow path. As stated in column 7,

beginning at line 9, "baffle member 60 and tube 80 force gas to flow inwardly from inlet 26, longitudinally through an annular passageway 68 between tube 80 and baffle member 60 and back through an annular passageway 63 between the baffle member 60 and the sidewall 56 before exiting through the outlet 28." Applicant contends the reactor and subsequent flow path disclosed by Mundt can not be considered an internal flow surface that is substantially absent projections or recesses that alter the effluent flow path.

Mundt, in this respect, is similar to the prior art discussed in the background section of Applicant's specification. On page 2 of the specification, Applicant discusses the disadvantages of reactors that have altered effluent flow paths. As stated on page 2, lines 24-28, "The circuitous pathway of the effluent gas reduces the rate at which the process gas effluent can be removed from the process chamber and treated to remove hazardous gas content. It is desirable to have a gas treatment apparatus having an effluent flow pathway that is not circuitously directed..." This disadvantage of altered flow paths is acknowledged by Mundt in column 7, lines 54-57: "In order to maintain unrestricted flow, it is desirable that the flow cross-section in reaction chamber 18 be approximately a factor of ten larger than the flow cross-sections of inlet 26 and outlet 28." Applicant, on the other hand, does not require this type of modification. Instead, Applicant has invented a gas treatment apparatus, as claimed in claim 1, that does not alter the flow of the gas. The resulting advantageous apparatus, for example, does not have to be made unduly large to prevent the backflow of effluent back into a process chamber.

Mundt teaches against and fails to disclose or suggest the invention of claim 1. Furthermore, it would not be obvious to one of ordinary skill in the art to modify Mundt to arrive at the invention claimed in claim 1. Claim 1 requires that the exhaust tube has an internal flow surface that is substantially absent projections or recesses that alter the effluent flow path. For Mundt to be modified to remove its

projections or recesses that alter the effluent flow path, the tube 80, the baffle 60, the fibrous mesh reactive element 74, and the fibrous mesh condensation element 76 would have to be removed. The removal of these parts would result in an inoperative device and is therefore taught against by Mundt. As discussed above and in column 8 of Mundt, the reactive element and the condensation element must interact with the effluent to reduce the undesired material from the effluent.

Mundt fails to disclose or suggest that which is claimed in claim 1 and therefore cannot anticipate the claim. Claims 2 and 31 depend from claim 1 and distinguish over Mundt for the same reasons as their base claim.

Furthermore, claim 2 includes the further limitation that the exhaust tube comprises a length that is sufficiently long to reduce the hazardous gas content of a continuous stream of effluent flowing through the exhaust tube without recirculating the effluent in the exhaust tube. Clearly, Mundt has recirculation in the chamber. In contrast, Applicant's exhaust tube does not substantially recirculate the effluent in the exhaust tube. Therefore, Mundt cannot be considered to anticipate claim 2. The Examiner's remarks that Mundt "implicitly does not require a reflux line for his apparatus" and "because no recycle line exists upstream or downstream of the vacuum pump system ... implies that a recirculation of the process gas is unnecessary" are not fully understood. Applicant is referring to, and has claimed, the absence of recirculation **in the chamber**.

Additionally, in contrast to Mundt, amended claim 11 is directed to a process chamber for processing a substrate and reducing emissions of hazardous gas to the environment comprising, inter alia, a gas analyzer capable of monitoring the hazardous gas content of the effluent in the exhaust tube and providing an output signal in relation to the hazardous gas content of the effluent and a computer controller system capable of monitoring the output signal from the gas analyzer and performing

an action in response to the hazardous gas content of the effluent. Mundt fails to disclose that which is recited in claim 11. Mundt discloses a pressure monitor 36 and a controller that is responsive to the pressure signal and controls the operation of the apparatus in accordance with the detected pressure. Mundt's pressure detector is not a gas analyzer capable of monitoring the hazardous gas content of the effluent in the exhaust tube and providing an output signal in relation to the hazardous gas content of the effluent. Mundt fails to teach or suggest the use of a gas analyzer. Nor does Mundt teach or suggest a controller that is responsive to the output signal from the gas analyzer and that performs an action in response to the signal from the gas analyzer. Therefore, Mundt does not anticipated amended claim 11.

It is respectfully requested that the rejection of claims 1, 2, 11, 31, and 33 as being anticipated by Mundt be withdrawn.

Rejections under 35 USC 103(a)

Mundt in view of Chiu

Claims 3-5, 8, 9, 11, 12, 14, 32, and 34 were rejected under 35 USC 103(a) as being unpatentable over Mundt in view of U.S. Patent 4,735,633 to Chiu (Chiu). The rejection is respectfully traversed.

Claims 3-5, 8, 9, and 32 depend from claim 1. As discussed above, amended claim 1 is directed to a gas treatment apparatus for reducing a hazardous gas content of an effluent from a process chamber comprising, inter alia, an exhaust tube to reduce the hazardous gas content of the effluent and having an internal flow surface that is substantially absent projections or recesses that alter the effluent flow path. Mundt discloses no such exhaust tube. Instead, Mundt has numerous projections and/or recesses that alter and convolute the flow path and that are necessary to the

operation of the device and therefore would not be obviously removable, as discussed above.

Chiu does not make up for the deficiencies of Mundt. In fact, Chiu teaches the addition of even more projections and/or recesses. Chiu teaches a spiral electrode projection that alters and redirects the flow path of the gas even beyond the altered flow path of Mundt. For example, in column 5, lines 18-21, Chiu states, "To effect complete removal of the waste vapor molecules, ... it is necessary to increase the ratio of electrode area to reactor volume." To achieve this, in one embodiment, nested spiral electrodes 20, 22 are provided. "The gas flow will generally distribute around the **spiral flow paths** ... In addition to the spiral flow established by the spiral electrodes, there will be **cross-flow** established through gaps 32 ... such cross-flow helps establish uniform distribution of the effluent gas throughout the reaction chamber" (column 6, line 68 through column 7, line 9). In another embodiment, electrodes 60, 62 are stacked. "The flow path generally spreads **radially outward ... and then radially inward**" (column 7 lines 33-36) as shown in Figure 3. In yet another embodiment, a plurality of concentric rings of upper and lower electrodes 102, 104 create a convoluted gas flow path as shown in Figure 5. Such configurations that control and alter the flow of effluent into a spiral or circular flow path, outward and inward flow paths or flow paths like that shown in Figure 5 cannot be considered to teach a flow surface that is substantially absent projections or recesses that alter the effluent flow path" as recited in claim 1.

The Examiner contends on page 7 of the office action, that "Figures 1-6 also support flow surfaces absent of [sic] projections and or [sic] recesses." The position of the Examiner in this regard is not fully understood. Applicant has carefully studied Figures 1-6 and has been unable to find any unaltered flow path in the figures. Applicant contends, rather, that Figures 1-6 show exactly that which the specification of Chiu is drawn to and exactly that which Applicant's claim 1 distinguishes over.

Since Mundt and Chiu fail to disclose or suggest all that is recited in claim 1 and since claims 3-5, 8, 9, and 32 include all of the limitations of claim 1, these claims distinguish over the proposed combination of references and the 35 USC 103(a) rejection of claims 3-5, 8, 9 and 32 should be withdrawn.

Claim 11, as discussed above, distinguishes over Mundt in its recital of a gas analyzer. Chiu discloses an analyzer, but merely in a test system configuration, see column 8, line 53 through column 9, line 36. Chiu, therefore, does not disclose a controller that performs an action when the hazardous gas content exceeds a safety level, as required by claim 11. This valuable feature of the invention allows for a safeguard against unwanted release of undesirable gases and against system malfunction. Since Mundt and Chiu fail to disclose or suggest all that is recited in claim 11, it is respectfully requested that the rejection of claim 11, and of claims 12, 14, and 34 depending therefrom, based on Mundt and Chiu be withdrawn.

Mundt in view of Itoga et al.

Claim 6 was rejected under 35 USC 103(a) as being unpatentable over Mundt in view of JP51-129868 to Itoga et al (Itoga et al). The rejection is respectfully traversed.

Claim 6 depends from and includes the limitations of claim 1 and further comprises a reagent gas mixer adapted to mix reagent gas with the effluent to further reduce the hazardous gas content of the effluent.

Itoga et al does not teach or suggest a microwave energy applicator, as required by claim 1 from which claim 6 depends, adapted to energize the effluent flowing through an exhaust tube, nor does *Itoga et al.* teach or suggest the advantages

of using a microwave energy applicator. Thus, Itoga et al. does not disclose or suggest that which is recited in claims 1 and 6.

As discussed above, amended claim 1 is directed to a gas treatment apparatus for reducing a hazardous gas content of an effluent from a process chamber comprising, inter alia, an exhaust tube to reduce the hazardous gas content of the effluent and having an internal flow surface that is substantially absent projections or recesses that alter the effluent flow path. Mundt discloses no such exhaust tube. Mundt has numerous projections and/or recesses that alter the flow path and that are necessary to the operation of the device and therefore would not be obviously removable, as discussed above. Furthermore, Itoga et al provides no suggestion or motivation to modify Mundt to reach the invention of claim 1. Therefore, one of ordinary skill in the art would not have found it obvious to modify Mundt to remove the projections and/or recesses therein. Thus, claim 1 is not rejectable under 35 USC 103 based on Mundt and Itoga et al, and since claim 6 includes all of the limitations of claim 1, it too is not properly rejectable. It is requested that the rejection of claim 6 be withdrawn.

Mundt in view of Labib et al

Claims 7 and 15 were rejected under 35 USC 103(a) as being unpatentable over Mundt in view of U.S. Patent 5,426,000 to Labib et al (Labib et al). The rejection is respectfully traversed.

Claims 7 and 15 depend from claims 1 and 11, respectively. Since claims 1 and 11 distinguish over Mundt for the reasons given above, and since Labib et al does not teach an unaltered flow in an exhaust tube (claim 1) or a gas analyzer (claim 11), claims 7 and 15 distinguish over Mundt and Labib et al for the same reasons as their base claims.

In addition, claims 7 and 15, explicitly state that the exhaust tube comprises monocrystalline sapphire. Mundt does not disclose or suggest the use of monocrystalline sapphire. The Examiner relies on Labib et al to teach the use of monocrystalline sapphire and posits that it would have been obvious to use monocrystalline sapphire as the chamber material in Mundt. Applicant respectfully disagrees with this conclusion of obviousness on several levels. In the first place, Labib is non-analogous art. One of ordinary skill in the hazardous gas reduction art would never look to the gas turbine engine art to improve on a reaction chamber material. In the second place, Mundt fails to provide any suggestion that there is a need to replace the quartz chamber described therein. In the third place, Labib does not even teach the advantages of any use of monocrystalline sapphire. Labib's mere mention of sapphire in column 1 is a discussion of the prior art relative to gas turbine engines. Labib's invention has little to do with monocrystalline sapphire and one of ordinary skill in the art would not be moved, after reading Labib's description, to modify Mundt by replacing the chamber material. The Examiner states on page 8 that "Labib et al demonstrate the common industrial application of sapphire." Applicant is unable to find this demonstration within Labib et al. Furthermore, it is unclear which industry the Examiner finds monocrystalline sapphire to be commonly applied in.

It is respectfully requested that the rejection of claims 7 and 15 under 35 USC 103(a) be withdrawn.

Mundt alone

Claims 10, 16, 24, 26-29, and 35 are rejected under 35 USC 103(a) as being unpatentable over Mundt. The rejection is respectfully traversed.

Amended claim 10 is directed to a gas treatment apparatus for reducing a hazardous gas content of an effluent from a process chamber comprising, inter alia, a

gas analyzer capable of monitoring the hazardous gas content of the effluent and providing an output signal in relation to the hazardous gas content of the effluent, and a computer controller system capable of monitoring the output signal from the gas analyzer, and when the hazardous gas content of the effluent exceeds a safety level, performing at least one of the following:

- (i) adjusting a power applied to the microwave energy applicator to reduce the hazardous gas content in the effluent,
- (ii) adjusting process conditions in the process chamber to reduce the hazardous gas content in the effluent,
- (iii) activating an alarm or metering display,
- (iv) adding a reagent gas to the effluent before or after the effluent is energized, to reduce the hazardous gas content in the effluent, or
- (v) terminating the process being conducted in the process chamber.

Mundt does not disclose the invention of claim 10. Mundt discloses a pressure transducer, not a gas analyzer. The Examiner contends that the measured pressure is relatable to the hazardous gas content and is therefore a gas analyzer as required by the claims. The Examiner then goes on to state that it would be obvious to move the pressure sensor. Applicant disagrees with the Examiner's characterization of the pressure sensor of Mundt.

The fact that other information might be derivable from the pressure data monitored by Mundt does not make Mundt's pressure sensor anything but a pressure sensor. Mundt does not disclose any analysis routines or any circuitry that takes the pressure signal and makes any gas analysis determinations. Mundt uses the pressure signal to monitor and control **pressure** in the Mundt apparatus. To alter the signal of Mundt would destroy this feature of the invention. Furthermore, Mundt and the

Examiner's modification are both silent on the limitation of "when the hazardous gas content of the effluent exceeds a safety level..."

The Examiner may not construct Applicant's invention using hindsight reasoning. There must be some suggestion to make modifications, aside from the suggestions provided by Applicant's disclosure.

It is respectfully submitted that claim 10 distinguishes Mundt and is allowable thereover.

Claim 16 has been canceled and the limitations thereof have been incorporated into claim 11. Claims 11, 26, and 27 are allowable over Mundt for the same reasons as claim 10.

Claim 24 is directed to a process chamber for processing a substrate in a process gas and reducing emissions of hazardous gas to the environment comprising, inter alia, an exhaust tube comprising monocrystalline sapphire through which effluent from the process chamber may be flowed. Mundt fails to disclose or suggest an exhaust tube comprising monocrystalline sapphire. The Examiner has not applied a reference against claim 24 teaching the use of monocrystalline sapphire. Additionally, the cited references fail to teach the use of monocrystalline sapphire in a manner that would render claim 24 unpatentable. The withdrawal of the rejection of claim 24, and claim 35 depending therefrom, is requested.

Claim 28 is directed to a computer program product for operating a gas treatment apparatus and process chamber, to reduce the hazardous gas content of an effluent formed during processing of a substrate in the process chamber comprising, inter alia, a gas analyzer program code for receiving the output signal relating to the hazardous gas content of the effluent from the gas analyzer, and safety operational

program code that upon receiving an output signal that the hazardous gas content of the energized effluent exceeds a safety level, performs at least one of (1) adjusting process conditions in the process chamber to reduce the hazardous gas emissions, (2) operating an alarm to indicate a dangerous level of toxic or hazardous gas in the effluent, (3) providing a metering display that shows the level of emissions of hazardous gas, or (4) shutting down the process chamber. Mundt fails to analyze the hazardous gas content and fails to disclose a safety level, as discussed above.

Therefore, Mundt does not disclose or suggest the invention of claim 28, or claim 29 depending therefrom.

Mundt as applied to claims 24 and 28 and further in view of Chiu

Claim 25 is rejected under 35 USC 103(a) as being unpatentable over Mundt as applied to claims 10, 16, 24, and 26 and further in view Chiu. The rejection is respectfully traversed.

Claim 25 depends from claim 24. As discussed above, claim 24 is directed to a process chamber for processing a substrate in a process gas and reducing emissions of hazardous gas to the environment comprising, inter alia, an exhaust tube comprising monocrystalline sapphire through which effluent from the process chamber may be flowed. Mundt fails to disclose or suggest an exhaust tube comprising monocrystalline sapphire. Chiu, likewise fails to disclose or suggest the use of monocrystalline sapphire. Claim 25 is therefore allowable over Mundt for the same reasons as claim 24.

Claim 36 is rejected under 35 USC 103(a) as being unpatentable over Mundt as applied to claims 10, 16, 24, 26-29, and 35 and further in view Chiu. The rejection is respectfully traversed.

Claim 36 depends from claim 28. As discussed above, claim 28 is directed to a computer program product for operating a gas treatment apparatus and process chamber, to reduce the hazardous gas content of an effluent formed during processing of a substrate in the process chamber comprising, inter alia, a gas analyzer program code for receiving the output signal relating to the hazardous gas content of the effluent from the gas analyzer, and safety operational program code that upon receiving an output signal that the hazardous gas content of the energized effluent exceeds a safety level, performs at least one of (1) adjusting process conditions in the process chamber to reduce the hazardous gas emissions, (2) operating an alarm to indicate a dangerous level of toxic or hazardous gas in the effluent, (3) providing a metering display that shows the level of emissions of hazardous gas, or (4) shutting down the process chamber. Mundt and Chiu do not disclose or suggest that which is recited in claim 28. Therefore, claims 28 and 36 distinguish over Mundt and Chiu.

Claim 30

The Final Office Action has not rejected claim 30. Claim 30 depends from claim 28 and is believed to be likewise allowable. In addition, claim 30 recites a reagent gas program code that distinguishes over the applied references. Positive indication of the allowability of claim 30 is requested.

CONCLUSION

The above-discussed amendments and remarks are believed to place the present application in condition for allowance, and an early Notice of Allowance is respectfully requested. Should the Examiner have any questions regarding the above

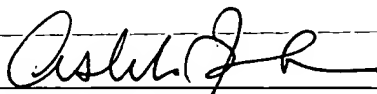
amendments, the Examiner is respectfully requested to telephone Applicant's representative at the number listed below.

Respectfully submitted,

JANAH & ASSOCIATES
A PROFESSIONAL CORPORATION

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By: _____


Ashok K. Janah
Reg. No. 37,487

Please continue to send correspondence to:

Patent Counsel
APPLIED MATERIALS, INC.
P.O. Box 450A
Santa Clara, California 95052
(415) 538-1555